GADSDEN'S SILENT OBSERVERS

An Introduction to

The Natural History of Southern Arizona

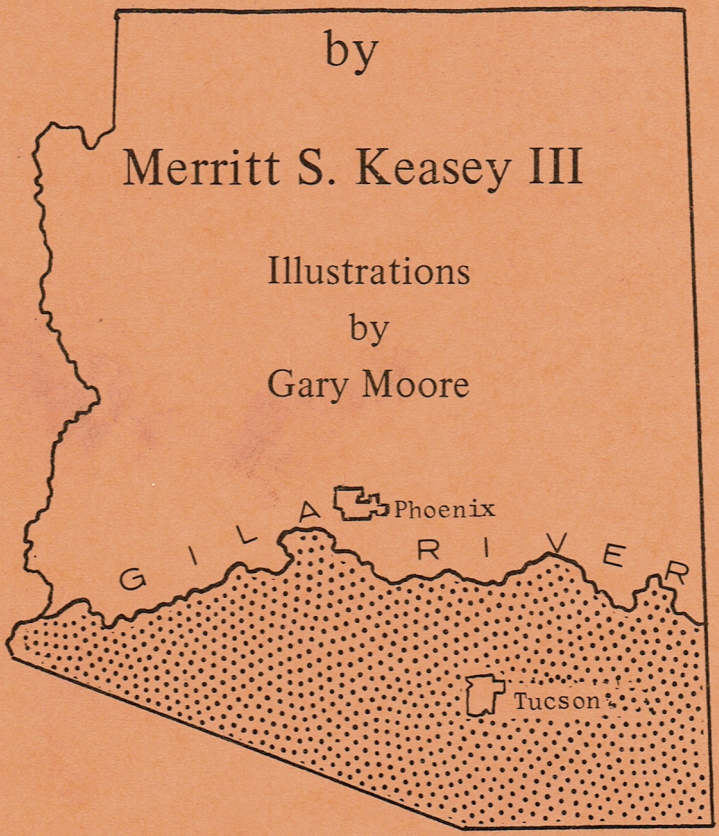
by

Merritt S. Keasey III

Illustrations

by

Gary Moore



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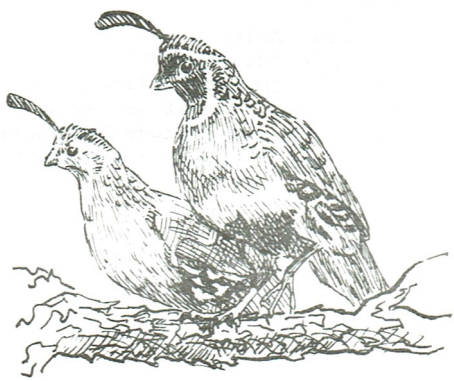

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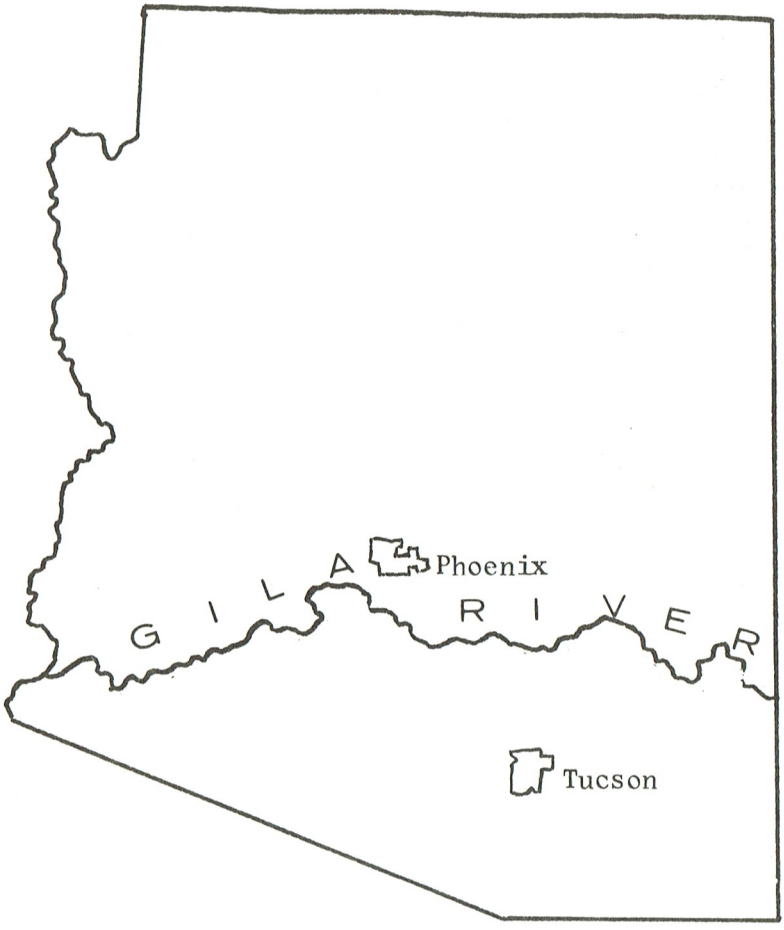

Phoenix
GILA RIVER
Tucson

INTRODUCTION

In 1853 the U.S. minister to Mexico, James Gadsden, negotiated a treaty which enabled the United States to purchase 45,535 square miles of land from the Mexican government. Bounded on the west by the Colorado River, on the north by the Gila River, and on the east by the Rio Grande, this territory—the Gadsden Purchase—was destined to figure greatly in the development of the entire southwest, for it was through this land that the southern transcontinental railway would be run.

Early Civilization

But the first chapter of this area's history starts long before the treaty-making efforts of James Gadsden. Archaeological evidence shows that mankind existed here thousands of years ago, in a time when even the flora and fauna were not as they are now. Known as the Cochise people, Arizona's first residents were primarily hunters, feeding upon the abundant big game animals that flourished here. Recently discovered campsites of these early people have been found to contain remains of elephants, camels, horses, sloths, bison, and tapirs—none of which are now native to this area.

With the eventual disappearance of these animals, the Cochise people were forced to turn to smaller game, or to crop raising. From their ranks there arose two tribal groups: the Anasazi, which took up residence in northern Arizona, and the Mogollon, a mountain-dwelling people who have been described as having a somewhat drab culture and were therefore slowly absorbed by other tribes.

One such tribe was the highly developed Hokokam, a desert-dwelling people who probably immigrated from further south in Mexico. With irrigation canals, the Hohokam brought stream water far into the arid desert land, enabling them to live where no other tribe had been able to survive. Much is known of their history from before the time of Christ to A.D. 1400, when their record fades away. Perhaps their well-organized society was disrupted by the influx of nomadic tribes, such as the Navajos and Apaches, but little is actually known about the reasons for their decline. Although there is some evidence to indicate that the modern-day Pima and Papago tribes are descendants of these remarkable desert dwellers, the mystery of the Hohokam remains buried in the sands of time.

The Legendary Spanish

The first white man to set foot upon what is now Arizona was the treasurer of an ill-fated Spanish expedition—Alvar Nuñez Cabeza de Vaca. Having been ship-wrecked in the Gulf of Mexico, Cabeza de Vaca and three other men, one a Negro slave, were held captive by Texas Indians for six years. After their release, the four men made their way westward, reportedly reaching this area somewhere between 1535 and 1536. Thus began Arizona's recorded history.

Cabeza de Vaca was impressed by what he had seen of this area. Upon his arrival in the Spanish stronghold of Culiacán he began to report it as being a land of fabulous wealth. This report touched off a series of expeditions seeking the fabled Seven Cities of Cíbola, whose portals were made of turquoise, and whose streets were lined with gold. These explorations, which included the famous one led by Governor Coronado, lasted until 1605, but with no discovery of rich cities. From that time until 1680 the Spaniards confined their ventures in the area mainly to those of a missionary nature, most of them being farther north among the pueblos of the Hopis where they met with little success.

The first missionary to concentrate his efforts upon southern Arizona was the Jesuit priest, Eusebio Francisco Kino, so well known in this area simply as "Padre Kino." Appointed as missionary to the Pimas in 1687, Kino began to work up and down the territory—mostly in what is now the state of Sonora—establishing twenty-five missions, a number of which are still active to this day. The northernmost of his works is the mission San Xavier del Bac, the "White Dove of the Desert," located just outside Tucson.

While the year 1776 was of great importance to our country, it was also one of importance to the Spaniards in Arizona territory, for during that year the Spanish pueblo of Tucson was founded. What had been a small Indian settlement became a walled city complete with a garrison of troops ready to defend it against the marauding Apaches. So it remained until the mid-1800s.

The Stars and Stripes Appear

In the 1820s—while Mexico attempted to keep her missions open, her mines operating, and the Apaches away from both—a new breed of men began to infiltrate from the east. These were the furtrappers, the "mountain-men," intent upon one purpose—to obtain the prized pelts of the beavers which were then so plentiful along the full-flowing rivers of that era. These men were the forerunners of many who would follow—men who were destined to take what they called their "Manifest Destiny" and make it a valuable portion of their own country.

On December 16, 1846, the walled city of Tucson was secured by a small group of United States infantrymen under the command of Lieutenant Colonel Philip St. George Cooke. No shots were fired by this volunteer Mormon battalion, for the Mexican garrison had already withdrawn. The American flag flew above the "Old Pueblo" as Cooke's men made camp along the banks of the Santa Cruz River.

At the end of the Mexican War in 1848, a treaty was drawn which gave a number of western states to the U.S. These included Arizona, but only that portion north of the Gila River. In 1850 the Territory of New Mexico was created, taking in this northern area. Then, in 1853, the Gadsden Purchase became a possession of the United States. On Feb. 24, 1863, after ten years

of fierce political debate, President Abraham Lincoln signed the bill which created the Territory of Arizona. But it was still a long way from statehood, for it was not until Feb. 14, 1912, that President William H. Taft signed the proclamation making Arizona the forty-eighth state.

The Silent Observers

One of James Gadsden's reasons for making his famous negotiation with the Mexican government was to provide a suitable route for the southern transcontinental railway which would be so vital to the economy of the entire southwest. Little did he realize that this vast territory was soon to become renowned for its natural history as well. Early explorers and surveyors—many also being avid naturalists-began to describe and record its rare and diversified forms of flora and fauna, the plants and animals which have long been the silent observers of man's ambitious endeavors in this land. These are the subjects of this book.

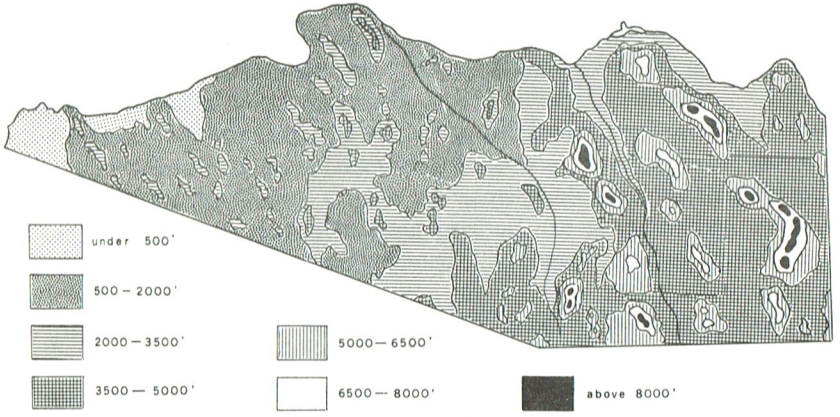
The following chapters describe not only a number of these plants and animals, but also the geology, soil, climate, and terrain: factors with which they are interrelated and without which they could not exist. Because of the need for a simplified system of maps and other data, this work does not cover that portion of the Gadsden Purchase east of the Arizona-New Mexico state boundary. Since the purpose of this book is that of an introduction, it can touch only briefly upon any individual or group of plants or animals. It is with this in mind that the reader is urged to check the reference list and to study the volumes covering the topics which most interest him.

TERRAIN, GEOLOGICAL STRUCTURE, SOIL AND CLIMATE

The four factors upon which this chapter is based are all interrelated, for together they determine which species of plants and animals can live here. In varying combinations they make up what is known as the natural environment: the surroundings in which each living thing exists. This is also called the "habitat." If the terrain, geological structure, soil, and climate were all entirely uniform across this area, then only a small variety of living things would be found here, for there would be only one type of habitat. But, because of differences in elevation, rock formations. soil types, rainfall densities, temperatures, and many other variable factors, southern Arizona consists of many types of habitats. Each contains its own specific groups of plants and animals, all dependent upon the above factors, and each other, for their existence. The study of this interrelationship of living things is called "ecology," a word which is often misused and misunderstood today.

The Terrain

In order to understand better why southern Arizona contains so many different and unique types of plant and animal life, one must first look at exactly the same thing which the early boundary surveyors and railway engineers were studying–the "lay of the land." At its southwestern corner–near Yuma, Arizona, on the Colorado River–the elevation is less than one hundred feet above sea level. On the eastern side at the New Mexico state line it averages around 5,000 feet. There is a wide variety of elevation between these two points, for both the desert and grassland which make up most of the area encompass large mountain masses, some reaching heights of over 10,000 feet.



Topographic Elevations

Probably one of the most confusing topographical features, particularly for newcomers, is the effect caused by the high terrain along the southeastern border. From this high country two major drainages—the Santa Cruz River and the San Pedro River—flow from the south to the north, quite in contrast to most rivers with which we are familiar. At the northern boundary of our described area these two rivers meet the westward-flowing Gila River, which gradually winds its way to Yuma, joining the southbound Colorado River whose waters ultimately empty into the Gulf of California.

In actuality, little, if any, of the intermittent streamflow travels this entire distance, most of it either being lost in the desert sands, or used up by man in his prodigious irrigation projects. When James Gadsden first looked upon this area, recognizing it as being of great potential, the streams still flowed freely over much of their courses, but with the advent of cattle, agriculture, and other commerce, this soon ceased. To fully realize the drastic changes which have taken place in this respect, the reader is urged to study the impressive work of Hastings and Turner, *The Changing Mile,* which is included in the reference list at the end of this book. Not only is it well written, but it also contains many photographic illustrations comparing the terrain of the early days with that of the present.

The majority of our area lies within the Sonoran Desert, a region which also extends westward into California and southward through major portions of the states of Sonora and Baja California in Mexico. It is one of four major divisions of the North American Desert which covers nearly 500,000 square miles of this continent. Rising out of this desert, like islands projecting above the sea, the mountain masses are scattered across the landscape, presenting a wide range of habitats for plants and animals that could not survive in the desert environment below.

The Geology

It is neither within the author's ability nor the scope of this book to give more than a thumb-nail sketch of the geological structure of this area. To say that it is complicated is quite certainly a gross understatement. Some portions of it are so discordant as to cause many geologists to shake their heads in wonderment and move on to easier tasks.

Most of southern Arizona lies within the Basin and Range Province. This is an area which has been greatly affected by folding, faulting, and volcanism. Metamorphic and granitic rocks make up many of the mountain ranges, while sedimentary beds of limestone, sandstone and shale are prevalent, as are basaltic lava flows. Through the gradual wearing down of these varied base rocks, our present soils have been formed.

The Soil

Most of the soils of southern Arizona consist of comparatively shallow

deposits of gravel, sand, and silt, the only deep soils being those along the flood plains of the major drainages. The soils of the thermic region—the low, flat or gently rolling areas between the mountains—consist of those developed from acid igneous alluvium. The lower mountainous areas are covered with shallow soils on the granite and schist parent rock, while the higher areas in the southeastern section contain shallow soils on parent rocks of limestone, granite and schist, or volcanic material. In the higher grassland areas, are soils developed from mixed alluvium. The exception to the above soil types is found in the area of Cochise County known as Willcox Dry Lake. This is a flat, isolated section entirely composed of saline-alkali soils and is the only such area in the entire state.

The Climate

Having briefly discussed the geological factors which shape the southern Arizona landscape into the form which it now possesses, we come to what must be considered the most important single factor of all in determining its array of flora and fauna—the climate. The macro-climate—that of the entire area—is governed by such major factors as the area's latitude, its inland location, and the rain-shadow effect caused by the large mountain ranges in California which block off much of the moisture-laden weather moving in from the Pacific Ocean. These combine to make it an area of warm temperatures and little precipitation.

Elevation plays a major role in climate changes across the area, for the lowest spots are the hottest and driest, while the high mountain peaks and ridges receive the most rainfall and have the lowest temperatures. Also the shape of the terrain affects climatic conditions, for south-facing slopes receive more sun and support different types of life than do the cooler, shaded north slopes.

Temperature ranges are extreme, ranging from over 120°F. in the low, western areas to sub-zero in the high mountains. In Tucson, the only large metropolitan area of the region covered by this book, the record high is 112° and the record low a very chilly 6°. Tucson's elevation is approximately 2350 feet above sea level.

Night-time temperatures, particularly in the desert regions, are much lower than daytime temperatures which may soar as much as thirty degrees from dawn to mid-afternoon. It is small wonder, then, that most of the desert's creatures seek shelter during the daylight hours and come forth only during the cooler periods from dusk to dawn.

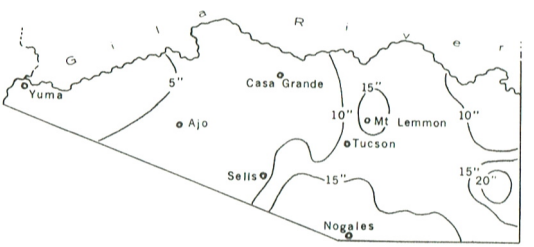
There is enough difference in temperature between summer and winter, even in the low desert, to bring about large changes in the activity of its inhabitants. Some species of birds migrate southward as winter approaches, reptiles and many other cold-blooded creatures become dormant, and a number of plants shed their leaves, just as they do in colder climes.

There are two rainy seasons in southern Arizona, the heaviest precipitation occurring in the months of July, August and September. During this period thunderstorms may occur almost daily, touched off by warm, moist air sweeping in from the Gulf of Mexico. Although usually small in area, these storms are often locally violent and may be accompanied by strong winds, hail, and intense lightning. Heavy rains may fall during these storms and flashflooding is common. Because of the prevailing flow of this storm activity, the extreme southwestern portion of the state receives much less rainfall during this period than does the southeastern corner.

Another type of storm may occur during the summer months, caused by large tropical disturbances off the west coast of Mexico. Although fairly rare in occurrence, these storms are often statewide, sweeping in from the southwest and causing much damage by flooding. Several inches of rain may fall in a period of only a few hours during one of these tropical storms.

The second rainy season occurs in the winter and is of a much different type. Usually of a more gentle nature, these winter rains gradually soak the ground, causing little runoff. They are part of very large storm systems moving in from the Pacific Ocean and are usually statewide. The higher mountain areas are often covered with snow during these storms. Occasionally heavy snowfalls will occur as low as 2,000 feet. If heavy, particularly during January and February, the winter rains are responsible for profuse spring blooming of numerous types of wildflowers. They are very sporadic, however; during some winters little rain will fall.

The amount of annual precipitation varies with elevation, the high mountains of southeastern Arizona receiving as much as twenty to thirty inches per year, the lower central portions averaging ten inches or more, and the western section receiving five inches or less.



Rainfall Map

Summary

By studying these four factors–terrain, geological structure, soil, and climate–and their relationship to each other, we should now be better able to see how they affect the distribution of plants and animals within this region. The varying combinations of these factors as they make up specific habitats where only certain types of living things can exist will be discussed in the chapters that follow.

LIFE ZONES AND VEGETATIVE TYPES

As has been noted, elevation is a major factor in determining which plants and animals can exist in a given location due to increasing or decreasing temperatures and amounts of precipitation. Because of these obvious elevational differences, biologists have developed the use of the "life-zone system" for dividing the floral and faunal communities into sections for easier study and research. C. Hart Merriam pioneered this system between the years of 1890 and 1910. Many of his findings are still widely accepted and used by scientists today.

The five life-zones of the area covered by this book are as follows:

The Lower Sonoran Life-Zone. This is desert country, ranging in elevation from 100 to approximately 4,000 feet. Its most prominent plant life consists of creosote bush, palo verde, and saguaro cactus, to name but a few. Most of the Gadsden Purchase area in Arizona lies within this life-zone.

The Upper Sonoran Life-Zone. This zone consists of grassland, chaparral, and woodland. It ranges in elevation from as low as 3,500 feet up to 7,000 feet in some places. Several species of oaks are the most prominent trees in this zone, along with mesquite, juniper, and some types of pines. Yuccas and agaves are also common.

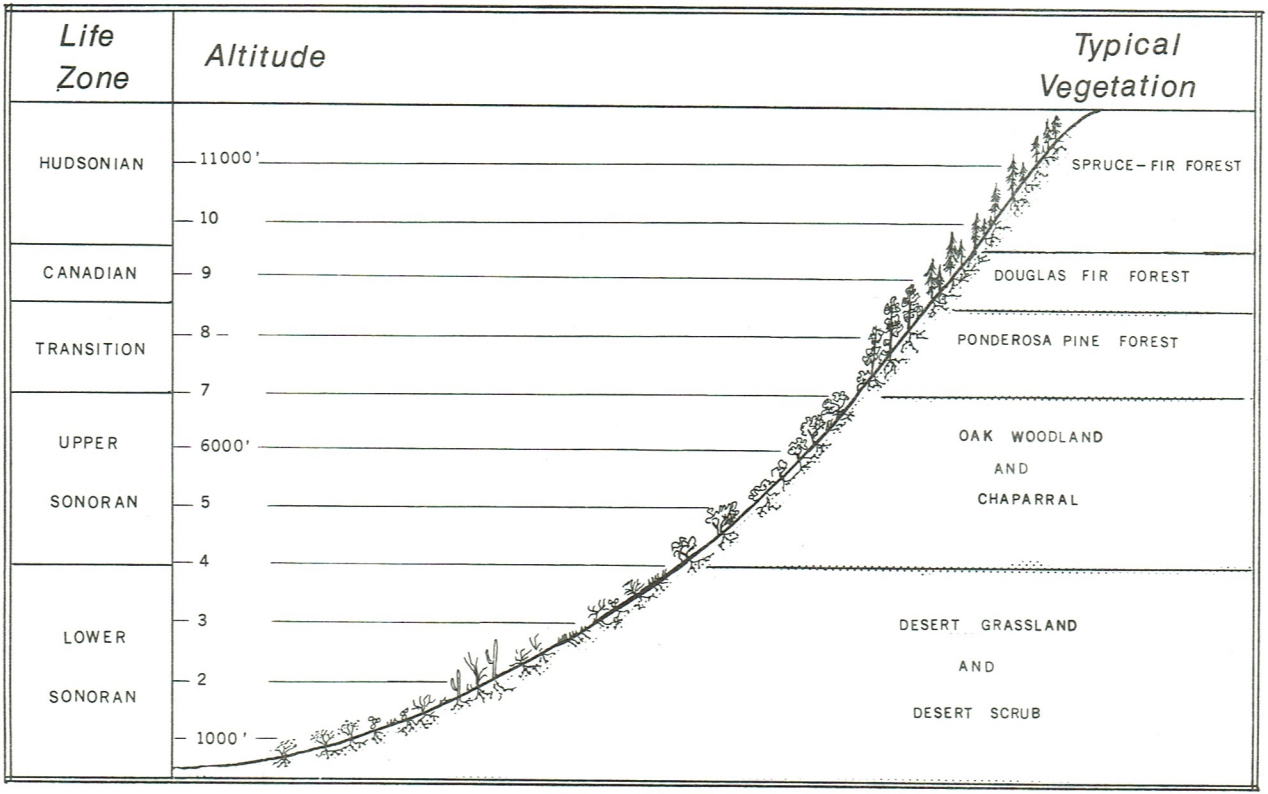
The Transition Life-Zone. . The ponderosa pine is the most common tree in this zone which covers an elevation range of 6,000 to 9,000 feet. Douglas fir and white pine are also here, along with several species of oaks, plus a number of broadleaf decidious trees, such as maple, aspen and alder. Because of its elevation, this zone is limited to small sections within the eastern one-third of our area.

The Canadian Life-Zone. Ranging from 7,500 to 9,500 feet, this zone is typified by Douglas fir and white fir. White pine and ponderosa pine are also present. Low temperatures with relatively high precipitation occur in this zone.

The Hudsonian Life-Zone. This is the highest and therefore the most restricted of the zones found within this area. Although more widely spread in northern Arizona, it occurs only around the summits of this region's two highest mountain ranges—the Pinalenos and the Chiricahuas—above 8,500 to 9,000 feet. Engelmann spruce—found in Arizona south of the Gila River only in these two ranges—is the dominant vegetation.

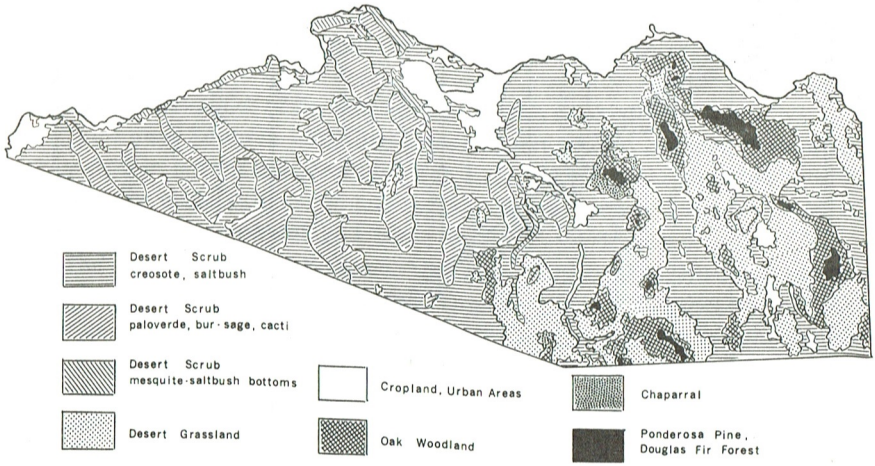
A clear-cut line cannot be drawn between the beginning of one zone and the ending of another. The typical vegetation of one zone—predicted by soil, temperature and moisture—will extend downward into the zone beneath it in the canyons, and upward into the one above it along the ridges. On south-facing slopes the lower limit of a zone will be at a higher elevation than on the cooler north-facing slopes. The edges of a zone are blurred, but within the zone the differences become very apparent.

One of the best ways to witness the changing zones with their indicative



Life Zone Chart

vegetative types is to take the drive from Tucson up to Mt. Lemmon in the Santa Catalina Mountains. Within approximately an hour's time, one passes through four of these five zones, the saguaros changing to oaks, the oaks to pines, etc. Signs pointing out these vegetative types, along with their corresponding elevations, have been erected by the U.S. Forest Service along this highway.



Vegetation Types

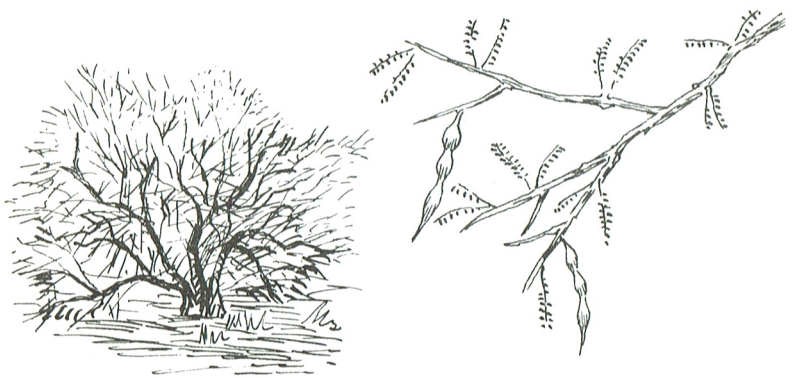
As we look from the Colorado River eastward across southern Arizona, we can see that most of the western half–along with vast portions of the eastern–is included in only one life zone, the Lower Sonoran. This means that there is primarily only one vegetative type–southern desert scrub, or southwestern desert scrub, as it is sometimes called. The plants included in this group are ones which must be able to live in shallow, sandy or gravelly, highly-acidic soils, and to withstand long periods of drought and high temperatures. Since they are usually very frost-sensitive, their upper limits of growth are restricted to the lower, comparatively frost-free areas.

Creosote Bush

Although the plants in the Lower Sonoran zone are many and varied, the most prominent and widely distributed of them is the creosote-bush *(Larrea divaricata)* which covers thousands of square miles of the low, flat land throughout the area. Most notable about this plant is its strong, but not too unpleasant, odor which permeates the desert air after each rain. Unlike many desert plants, the creosote-bush, does not have thorns or spines. Few animals eat it, however, because of its disagreeable odor and taste. As it blooms profusely, the bushes are covered with yellow blossoms or the fuzzy white fruits during most of the year.

Among the most common of trees in the low elevations are the palo verdes. The little-leaf or foothill palo verde (*Cercidium microphyllum*) lives on dry, rocky slopes and hillsides, while the blue palo verde (*Cercidium floridum*) is found chiefly along washes and flood plains. Both reach a height of approximately twenty-five feet. They have tiny leaves only during times of rain, losing them during each dry spell. Even the young bark of the palo verdes is green, making them easily identifiable. In the spring they are heavily-laden with brilliant yellow blossoms which attract many insects.

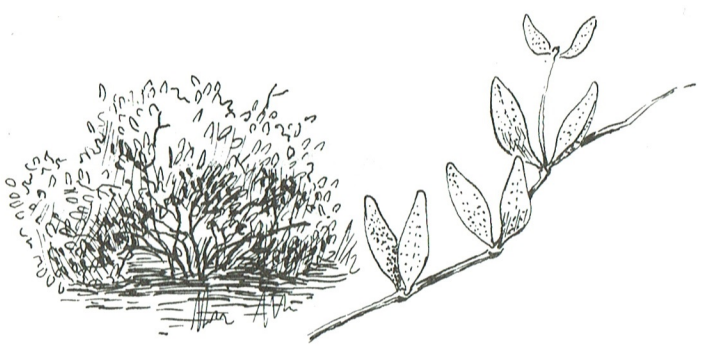
A third palo verde (*Parkinsonia aculeata*), also grows in the area, but is native only around the Castle Dome Mountains of Yuma County and the Coyote and Baboquivari Mountains of Pima County, being introduced into other parts of the state. It is a larger tree than the others, reaching a height of forty feet, and has much longer leaflets. It is often used as an ornamental in the cities of southern Arizona.



Foothill Palo Verde

Ironwood

Another common tree, and one which is also a very showy bloomer, is the ironwood (*Olneya tesota*). So named because of its extremely hard wood, it is very cold sensitive and grows only in areas that are almost entirely frost free. Its lavender flowers are shaped like those of the pea family, of which it is a member. After a hard winter the ironwood may not bloom at all, due to damage from the cold, but in a normal spring, the delicate shades of lavender mingle with the stronger yellows of the palo verdes to present an exquisite scene.



Jojoba

A shrub which has recently gained much prominence because of its wax-producing fruits is the jojoba (*Simmondsia chinensis*), which is considered to be the best browse plant in Arizona. These edible jojoba "nuts" are

now being harvested by the Papago Indian Tribe under a grant from the Office of Economic Opportunity. The liquid wax obtained from them is used as an additive to certain oils to increase their resistance to the high temperatures and pressures which exist in modern-day machinery. Sperm whale oil was once the only thing which would suit this need. The discovery of the special properties of the jojoba fruit will quite probably help to relieve the pressure upon these rapidly disappearing marine mammals.

Bur Sage

One of the most common of small perennial plants in the Lower Sonoran Life-Zone is the bur-sage (*Franseria sp.*). This low-growing member of the composite family is well-known to hay fever sufferers for its prodigious quantities of allergy-producing pollen, but it performs an extremely vital function of erosion control on desert slopes and hillsides.

The ocotillo (*Fouquieria splendens*), often mistakenly called a "cactus," is a unique plant with long, thorny stems which, like the palo verdes, are

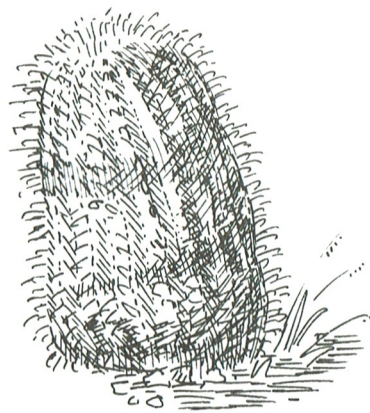
Ocotillo

covered with leaves only after periods of precipitation, losing them during each dry spell. In the spring, the end of each slender branch bears a tassel of orange-red flowers. The stems are often used by the Indians for protective fencing. The cut stem, if embedded in the ground, will often continue to grow, forming a living fence. Although primarily a desert plant, the ocotillo also occurs well up into the Upper Sonoran Life-Zone.

The plants which really typify the Lower Sonoran Life-Zone are its many different species of cacti. Although a number of plants—such as the ocotillo, yuccas, and agaves—are often mistakenly grouped with them, there are certain specific characteristics which identify the true cacti. They are usually leafless, succulent, and possess stems of one or more joints, with rows of protrusions known as areoles which bear the groups of spines. They are all flowering plants, many producing blooms of spectacular colors and proportions.

One of the best-known is the barrel cactus (*Ferocactus sp.*). These robust species with their large, curved spines are often written about in Western books and magazines as being the life-saver of the desert because of their water storage capabilities. While it is true that all cacti store moisture within their thick stems, it is only in the form of a fleshy pulp, and little free water could be obtained from it, not to mention the fact that such liquid from many species would be detrimental to the health of a thirsty traveler, due to its high content of toxic substances.

Although barrel cactus liquid is somewhat palatable, it is this author's opinion that the amount of work necessary to penetrate the formidable armor of this species to extract enough moisture to sustain life would, in most cases, use up more body moisture than could be gained in the process.



Barrel Cactus

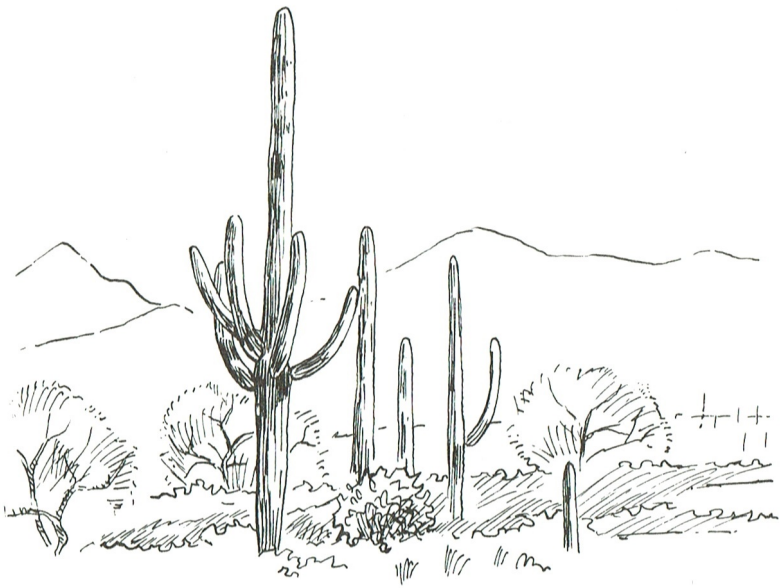
Jumping Cholla

The jumping cholla (*Opuntia fulgida*) is a large plant with a bad reputation. Its loosely-jointed sections, armed with long and finely-barbed spines, attach themselves to the unwary passerby with the least touch, often causing the victim to think that the plant actually jumped upon him. One of a number of species of chollas in the area, the jumping cholla—pronounced "chaw-yuh"—sometimes occurs in almost impenetrable thickets. But in groups or as an individual, each plant is a fortress in itself. Its formidably-spined branches provide protective cover for a vast array of small desert creatures.

Prickly Pear

Closely related to the chollas, but quite unlike them in outward appearance are the flat-padded prickly pears. One of the most common of

these is Engelmann's prickly pear (*Opuntia engelmanni*), a plant which may cover an area of several feet in diameter, its sprawling, spiny pads guarding the entrance to the burrows of many underground dwelling rodents and other wildlife. In the spring these cacti are covered with large, yellow blossoms which mature in the summer into the plump, dark red fruit so relished by many desert animals, including man himself.



Saguaro

Of all of the cacti, the largest, most spectacular, and probably the most important to the environment in which it occurs, is the giant saguaro (*Carnegiea gigantea*). Living up to 200 years, these huge specimen may reach a height of fifty feet. Their waxy white blossoms, which appear in May and June, have been chosen as the state flower of Arizona, while the red fruit pulp is harvested annually by the Papago Indians, as well as by many birds and other animals.

The saguaro usually grows on rocky slopes and hillsides, although it is sometimes found in well-drained areas in the flat lowlands. Its root system is extremely shallow, spreading out scant inches beneath the surface in all directions. This not only provides ample support for its great weight, but also enables the roots to pick up any moisture which may fall, even during the briefest of rains.

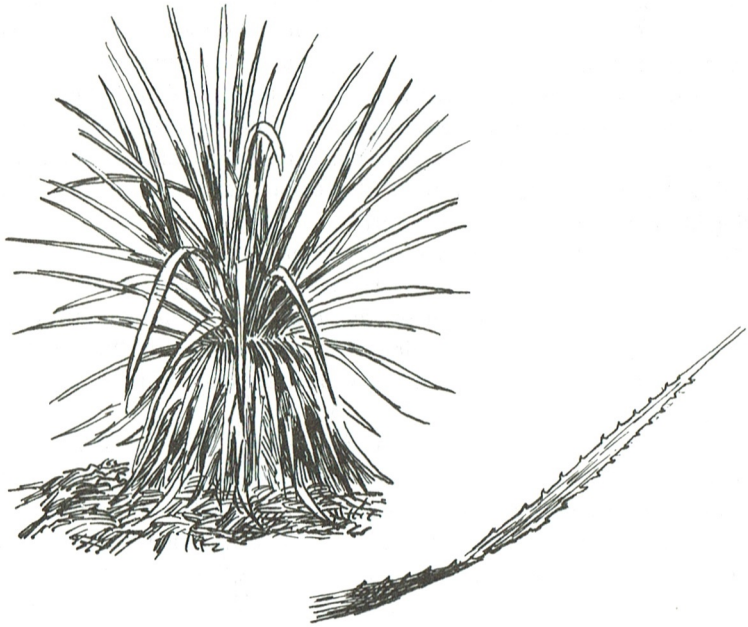
Any description of the plant life of the Lower Sonoran Life-Zone, no matter how brief, would not be complete without mention of the ephemerals.

Those small annuals spend most of their lives only as seed lying dormant beneath the parched surface, waiting for the right combination of rainfall and temperature to cause them to burst forth and cover the desert and foothills with a spectacular array of color. There are two groups, the spring annuals and the summer annuals. Of the two, the spring annuals are the most varied and showy, but with much less frequency of bloom than those of summer. The reason for this is that the winter rains are less dependable and only when the desert receives a large amount of precipitation early in the year do the spring-blooming ephemerals come forth.

Not only do the ephemerals bring beauty to the desert, but they also provide food for many insects. Beetles, grasshoppers, and the larvae of moths and butterflies are among these, all appearing in prodigious quantities following a heavy spring blooming. The relationship of the plants to the animals with which they share their environment will be more closely discussed in succeeding chapters.

In the eastern half of our area, around and between the higher mountain ranges, we find the grasslands and woodlands of the Upper Sonoran Life-Zone. These areas receive a little more moisture than the desert regions beneath them, while at the same time experiencing slightly cooler temperatures. Some of the plants which live in the Lower Sonoran Life-Zone are able to live here also. The ocotillo, barrel cactus, prickly pear, chollas and some of the ephemerals are among these. Frost-sensitive plants such as the saguaro and the ironwood are unable to survive and are replaced by plants which are more cold-hardy, but less drought resistant.

Soaptree Yucca



Sotol

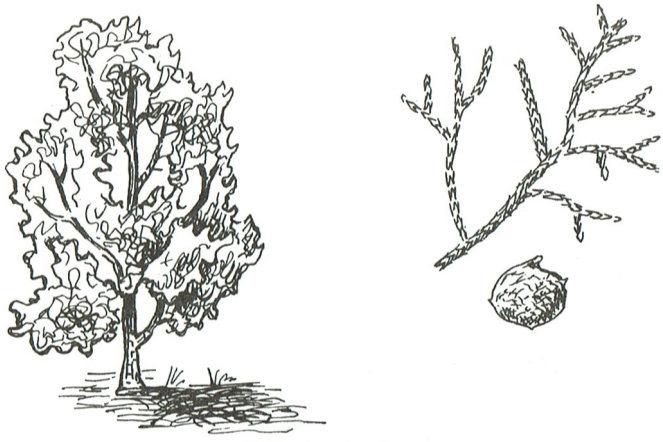
In the grasslands, the largest and most prominent plants growing in association with the many and varied species of grasses, are the yuccas and sotols, both members of the lily family. One of the most common of the yuccas is the palmilla (*Yucca elata*), also known as the soaptree yucca from the detergent qualities of its roots. These plants may grow to be thirty feet tall and in the spring send up tall sprays of large, whitish blossoms. The closely-related sotol (*Dasylirion wheeleri*) possesses long, thin, sharply-pointed leaves which branch from ground level, while the flower stalk is tall and candle-like in appearance.

The most common tree of the grasslands is the mesquite (*Prosopis sp.*). It is most prevalent along water courses, growing in large thickets, but is also found on mountain slopes, for its extremely long taproot—up to 60 feet—enables it to reach far down for its water source. This plant can be both a curse and a blessing to humans, for it can rapidly spread over grassland where cattlemen graze their stock, but at the same time its beans are edible, its trunk is hard, making excellent firewood and fence posts, and its flowers are considered by beemen to be second to none for the production of fine honey.

Mesquite

Emory Oak

In the woodlands of the Upper Sonoran Life-Zone, the Emory oak (*Quercus emoryi*) is found throughout the foothills and canyons. This tree, growing up to fifty feet in height, was used a great deal by Indians and settlers, for it not only made good firewood, but its acorns, less bitter than those of many other oaks, were commonly eaten.

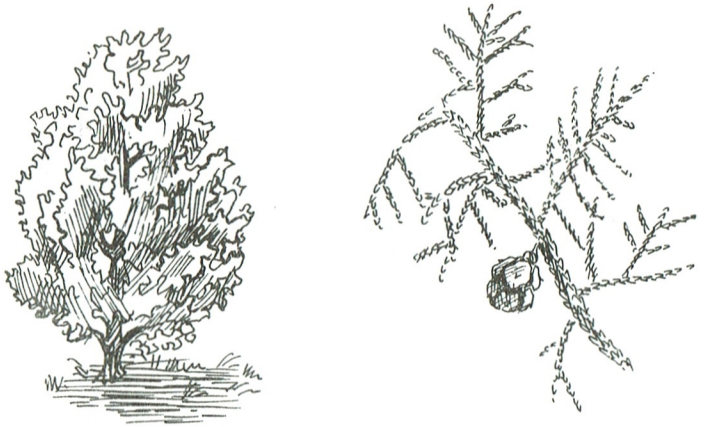


Alligator Juniper

The alligator juniper (*Juniperus deppeana*), named for its heavily-scaled bark, reaches a maximum height of sixty-five feet and is the largest of its genus in southern Arizona. The "berries" of this common evergreen are eaten by many birds and mammals.

Another tree of the woodland areas, and one which grows in close association with the alligator juniper, is the pinyon, (*Pinus edulis*) a pine tree of comparatively small size–usually less than thirty-five feet tall. It can grow at lower elevations than many pines, due to its drought-resistant characteristics. The edible pinyon nuts–which are actually the seeds from the pine cones–are very tasty and are harvested in great quantities for sale throughout the country.

Mexican Pinyon



Arizona Cypress

The largest of trees in the Upper Sonoran Life-Zone is the Arizona cypress (*Cupressus arizonica*). This evergreen grows to a maximum height of ninety feet and is usually found along canyons in conjunction with the oaks, junipers, and pinyons. Its leaves are scaly, quite similar in appearance to those of the alligator juniper, but the cones are larger and possess pointed scales.

Ponderosa Pine

Above the Upper Sonoran Life-Zone, the Transition Life-Zone has an average annual rainfall of eighteen to twenty-six inches, enabling it to support a variety of large trees, the dominant species being the well-known ponderosa pine (*Pinus ponderosa*). In the few mountain ranges of southeastern Arizona which are high enough to encompass this zone, these valuable lumber-

producing trees may occur either in pure stands, or in coexistence with other species. Reaching a height of 150 feet, the ponderosa pine may live to be as much as 500 years of age.

Several species of evergreen oaks are present among the stands of ponderosa pine, as well as white pine (*Pinus ayacahuite*), Douglas fir (*Pseudotsuga menziesi*), and a number of deciduous trees and shrubs. Many species of perennial herbs, ferns, and grasses blanket the forest floor beneath the protective canopy of these large trees.

Occurring in only five mountain ranges in our area, the Canadian Life-Zone is typically a fir forest, although both the ponderosa pine and white pine may occur there also. The Douglas fir is more dominant in the lower and south-facing portions of this zone, while the white fir (*Abies concolor*) prefers the cooler north slopes. Both reach a height of approximately 150 feet and an age of up to 400 years. Where areas of these large trees have been destroyed by fire or by other means, large stands of quaking aspen (*Populus tremuloides*) grow.

In only two of the mountain ranges, the Chiricahuas and the Pinalenos, the Hudsonian Life-Zone exists at the summits of a few peaks, dominated by the Engelman spruce (*Picea engelmanni*). Douglas fir and white fir may occur here also, along with a number of high-mountain shrubs, herbs and grasses.

The brief selection of plants which have been discussed in this chapter are only a small fraction of those which occur in this area, all of them existing in specific locations, determined within the area by climatic conditions. Together each group of plants forms a macro-habitat, within which are found many smaller micro-habitats. The following chapters will attempt to show how the many and diversified forms of animal life which live within these habitats are dependent upon the plants and each other, while the plants themselves share this inter-dependency for their own existence and propagation.

Douglas Fir

Quaking Aspen

THE ANIMAL LIFE

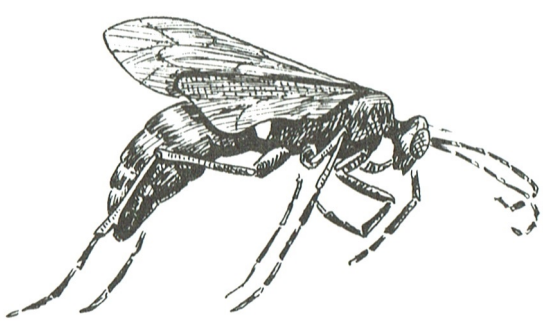
The plants which have been described in the preceding chapter have been listed according to their occurrence in man-made divisions known as life-zones. Animals, being much less restricted in movement than the plants, can not be categorized in this manner. Instead, they must be described as they really are, individual creatures performing their own specialized functions as integral parts of the particular habitat in which they live.

Throughout southern Arizona–even in the driest of desert areas–the animal life is extremely abundant and widely diversified in form, although often secretive and seldom seen. In the paragraphs which follow, a small selection of these animals are described. Those used to represent their own major group have been so chosen for several reasons: they are often seen, they have unique habits, or they are the most typical representative of their kind.

Some of these creatures are strictly low desert dwellers, while others live only at higher elevations. Still others are capable of traveling great distances and may be found throughout much of the elevational range. But all have one thing in common. From the tiniest of insects, to the largest of carnivores, all must depend for survival upon the plants and other animals with which they share the environment.

The Arthropods

There are many different types of invertebrates–creatures without backbones–found in this area, the most prevalent and noticeable group being the arthropods. These are animals which have external skeletons, segmented bodies, and jointed legs and antennae. The most common and well-known members of this group are the insects, distinquished from all of the others by the possession of six legs. There are literally tens of thousands of different species of insects in our area, outnumbering all of the other animals put together.



Tarantula Hawk

Insects occur in every possible habitat, from the tops of the tallest trees to the depths of the deepest caves; from the lowest part of the desert floor to the summits of the highest mountains; on dry land and in the water. Some of them burrow into the ground, some of them tunnel into wood, and many fly.

Many of the flying insects–particularly the bees, wasps, and certain types of beetles–are vitally important to the propagation of the flowering plants, carrying out the job of pollination while in search of nectar which the flowers provide. Some are hunters, preying upon caterpillars, spiders, and other arthropods. Some actually carry out both of these functions. One such insect is the large wasp known as the tarantula hawk, *(Pepsis sp.)*.

There are a number of these brilliantly-colored wasps, some entirely dark blue in color, while others possess orangish-red wings. Circling back and forth in the air, or running rapidly along the ground, a tarantula hawk covers much territory in its search for the large, hairy spider for which it is named. Once the spider is located, the wasp begins to circle it cautiously, trying to find an opening where it can slip beneath the spider's body to paralyze it with a thrust of its long stinger. One slip here and the hunter can become the victim, for the spider itself possesses a powerful venom.

After a sparring match which may last for several minutes, the agile wasp is usually successful in planting the stinger into the spider's soft adbomen, and the fight is over. But not the work, for now the adult wasp–which is itself a nectar feeder–must drag the heavy, paralyzed form to a nearby hole where it will lay a single egg upon the inert spider, thus providing food for the larva which will soon hatch. Feeding upon the still-living body of the spider, the little larva will gradually grow until it pupates, later hatching out as an adult wasp to continue the cycle.

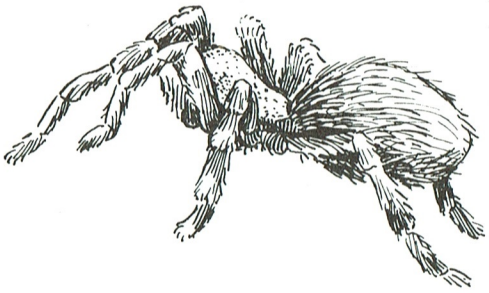
This large, winged insect carries out several important functions during its short life span. Being a nectar feeder it insures the spreading of pollen. Secondly, it helps to maintain the population balance of a species of spider which is fed upon by few other creatures, and finally, it may, itself, become the food item of some larger predator.

While the tarantula hawk has a powerful sting which can also be used for defense, many insects must rely upon other methods for protection. Some have powerful jaws which can give a painful pinch, while others depend upon speed for escape, or upon mimicry to avoid detection. But some have none of these capabilities and must rely upon an entirely different type of defense.

One such insect is the pinacate beetle *(Eleodes sp.)*, an inch-long, shiny black creature which can neither sting, bite, fly, or blend in with its surroundings. Like most beetles, it possesses a very hard outer shell, yet its most convincing protection is not its armor plate, but the fact that it is capable of emitting a strong chemical deterrent, much in the manner of the skunk. When one of these beetles is threatened, it raises its posterior high into

Pinacate Beetle

the air, warning the predator to stay clear. If this warning is not heeded, it discharges a fine spray of a noxious substance, which discourages most creatures which would otherwise dine on the beetle. However, some creatures are not deterred by the beetle's efforts; the evidence of many pinacate beetle shells in the bottom of tarantula holes indicates that the hairy spider is one of them. The tarantula itself is not an insect, but belongs to another group of arthropods known as arachnids. Arachnids have eight legs instead of the six possessed by the insects. This group includes the spider, scorpions, mites, ticks, and other closely related creatures. Tarantulas are not only the largest of the group, but also live longer than other arachnids, the females for as long as twenty-five years.



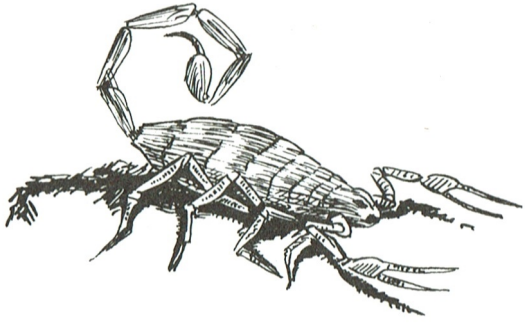
Tarantula

Although often thought of as extremely dangerous creatures, these large, common spiders *(Aphonopelma sp.)*, are quite docile, delivering a painful, but non-lethal bite only upon extreme provocation. Many people in the southwest, even small children, freely handle these furry spiders, letting them walk up and down their hands and arms without any fear of being bitten.

The tarantula is only one of several hundred different species of spiders living in this area, all but two of them being practically harmless. One which is not is the black-widow spider *(Latrodectus mactans)*, which is found throughout the United States. It is easily recognized by the round, shiny-black or dark brown body, and the red hour-glass on the underside of its abdomen. Its habit is to hang upside down in its web and the hour-glass is usually quite visible.

Hiding in a crevice or corner during the day, the black-widow comes out at night to feed upon the insects caught in its strong, but scraggly-looking web. A bite from one of these is brought about only as a defensive measure when a person comes in actual physical contact with the spider. Such a bite brings immediate pain and is often followed by abdominal cramps and vomiting. Due to improved treatment, there have been few deaths from black-widows in recent years.

The only other spider to cause concern to humans is the little brown creature known as the violin spider *(Loxosceles sp.)*., Also known as the brown recluse, the three species of this spider which occur in Arizona are all small and inconspicuous. They are distinquished from other spiders in the area by the possession of only six eyes–others having eight–but this fact is determined only with a hand lens due to their small size. The bite of the brown spider may or may not cause systemic reaction, but it often causes an ugly, ulcerating wound which gradually spreads farther and farther, causing a great deal of tissue damage unless properly checked. It is a wise precaution to consult a physician upon any occasion of bite or sting.

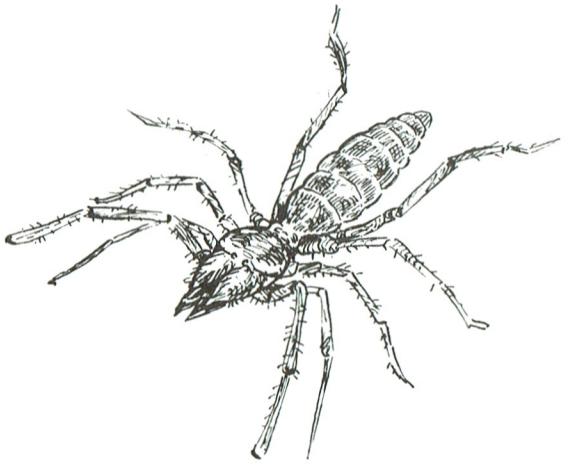


Bark Scorpion

Often considered even more dangerous than the black-widow and brown recluse spiders is another arachnid, the bark scorpion *(Centruroides sculpturatus)*. While there are several species of scorpions in southern Arizona, this is the only one which is dangerous to man. The others–some of which are much larger than the bark scorpion–give a painful sting, but with a local reaction and swelling only. The sting of the bark scorpion does not produce swelling, but is followed by much pain, a tingling sensation of the stung member, and in severe cases, vomiting and other systemic reactions.

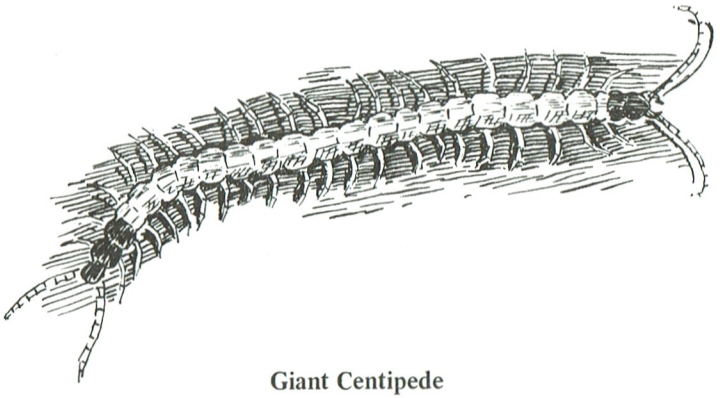
Bark scorpions are small, slender, straw-colored creatures which generally cling to the underside of rocks, bark, and other debris. They are found in a wide variety of habitats, but seem to be especially prevalent in the saguaro

forests and along stream-beds in association with cottonwood trees, where they often hibernate together in large numbers. To avoid the sting of a scorpion, one should always use a great deal of caution in picking up anything from the ground.



Solpugid

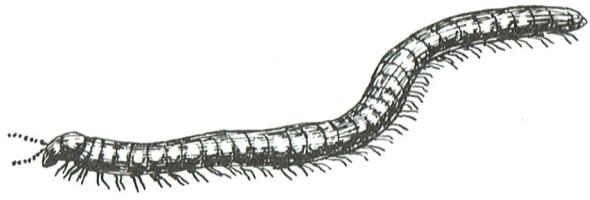
An arachnid which is neither spider nor scorpion, but is often mistaken for both, is the solpugid *(Eremobates sp.)*. Locally known as the sun-spider, this non-venomous creature is fast-moving and ferocious looking, but is harmless and quite beneficial, for it feeds upon many insects and other pests, including the dangerous black-widow spider. These tan-colored arachnids with the large black jaws are often found in dwellings, rapidly running about in search of food.



Giant Centipede

Another group of arthropods which are quite prevalent in the area are the centipedes. Although the name implies the possession of one hundred legs, this is not quite true, for different species have different numbers of legs. The largest of the group is the giant desert centipede *(Scolopendra heros)*, which attains a length of eight inches, with legs numbering forty-two. There are many other species of centipedes here, some closely resembling this one, while others are quite different in appearance, having longer, thinner legs and antennae. Centipedes are found in the mountains as well as in the desert regions. All feed upon insects and other small creatures, and can give a venomous bite which is painful but not generally considered dangerous.

Sometimes mistakenly identified as centipedes is another group of many-segmented creatures known as the millipedes. These possess more legs—two pairs per segment in contrast to the one pair per segment of the centipedes—and are primarily vegetarian. They are much slower moving and do not bite, but protect themselves by secreting a substance which keeps them from being eaten by most creatures. There are many different species of millipedes, both in the mountains and in the desert areas. Since it is their habit to become more active during the summer rains they are often called "rainworms," and are frequently seen crossing the roadways during this season.



Millipede

Aquatic and Riparian Habitats

There are many arthropods which make their homes in the water, at least in the larval stage. Wherever water is found, even in temporary rain pools, a wide variety of life exists. Crustaceans, arachnids, and insects abound in large numbers, along with other types of invertebrates such as snails, clams, leeches, and flatworms. They feed on small plants and animals and, in turn, become food for many larger creatures.

There are several different types of natural aquatic habitats in southern Arizona—the temporary rain pools, a few permanent ponds, the canyon streams, and the river habitats. There are also several which are man-made—the artificial lakes, many of the permanent ponds, and the irrigation canals and their overflow areas. Each contains its own particular species of aquatic wildlife.

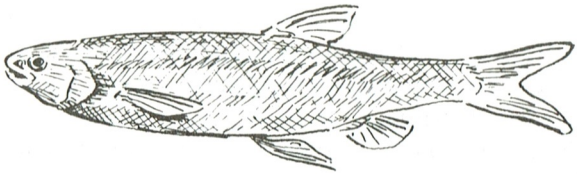
Along the river and stream beds, and around the edges of the lakes and ponds, occur the riparian habitats, those areas which receive the sub-surface moisture, thereby allowing many different plants and animals to live within an environment where they would otherwise be unable to exist. Large trees, such as cottonwoods, sycamores, and ash, grow here, providing habitat niches for many species of mammals, birds, reptiles, and insects. These in turn attract parasites, predators, and other plants and animals with which they coexist.

The insect life around the aquatic and riparian habitats is extremely abundant. Dragonflies flit back and forth, catching smaller winged insects in the basket formed by their legs, resting momentarily upon a twig or stem to devour the prey. Beneath the water's surface, the dragonfly larvae wait in concealment, ready to lash out with their extendable jaws at any hapless tadpole, minnow, or insect which may venture too close to their hiding place.

They are joined in their constant quest for food by many other larval forms of insects which live in the watery environment, including those of the flies, mosquitos, and beetles. Adult beetles, such as the whirligigs, predaceous diving beetles, and the water scavengers, are present, both on the surface and beneath, as are numerous representatives of the family of insects known as the true bugs. These include the water-striders, water boatmen, back-swimmers, water scorpions, and giant water bugs. The latter, especially, are extremely voracious creatures, attacking frogs, fish, and even baby turtles, grasping them with their powerful front legs and sucking them dry with their long, pointed beaks. They, and many other adult water insects, are capable of flight, and can move from one pond or stream to another, should the water level drop, or the food supply dwindle.

There are several creatures which exist only in the temporary rain pools, and are unable to leave, in spite of such ephemeral conditions. There are the tiny fairy shrimp and tadpole shrimp, both crustaceans and related to the much larger crayfish which are often found in the canyon streams. The fairy shrimp is an elongated, almost transparent, delicate-looking creature, one-half to three-quarters of an inch in length, which swims upside down. It is often seen in these pools in great quantities and provides food for many of the predaceous larval forms of insects which also live there.

The tadpole shrimp has a round, flattened shell, with a protruding forked tail. It is only slightly larger than the fairy shrimp, and spends most of its time on the bottom muck of the pool. Both of these crustaceans are extremely short-lived, as is their rain-pool habitat. They lay their eggs in the mud, which soon dries and hardens. There the eggs remain until the next large storm fills the pool, causing them to hatch. While in some areas this may occur several times during a season, in others it may not come again for a year, or even longer, yet the encapsulated eggs remain viable until the pool is filled.



The Fishes

The insects, crustaceans, and other arthropods of the aquatic habitats are only part way up a hypothetical food chain which has its foundation in the freshwater plankton—that almost unimaginable combination of tiny plants, animals, and other living things which are not easily classified as either. Feeding upon this vast array of edible material, the insects and other large invertebrates are in turn fed upon by even larger animals—particularly the fishes.

To understand best the position of this group of animals which breathe through gills and possess fins and scales, one must go back in history to a time when modern civilization had not yet begun to seriously affect their populations—the mid 1800s. It was a time when the Apache renegades still raided the settlers, and Mexican bandits crossed into the newly-purchased territory to loot and burn. But, surprisingly enough, one of the greatest dangers to mankind in this area was not the Mexicans or the Apaches, but the mosquito-spread disease of malaria.

In the mid 1800s the rivers of southern Arizona flowed continuously and were lined with lush stands of cottonwoods, willows, and other vegetation. Beaver dams dotted the river-courses and numerous marshes and lagoons provided rich habitat for a wide variety of wildfowl and other creatures, including the fishes. There were many native species, some of them as large as the humpback sucker *(Xyrauchen texanus)*, which reached a length of nearly three feet and a weight of fifteen pounds. The real giant of the area, however, was the now almost extinct Colorado River squawfish *(Ptychocheilus lucius)*. This large fish was once quite common in all of the rivers and was found almost as far south as Benson in the San Pedro River. It reportedly weighed up to 100 pounds and reached a length of close to six feet. Both of the above mentioned fishes are now extremely rare and are found mostly in the lower Colorado River.

The native trout *(Salmo gilae)*, was also abundant in those days in the higher mountain streams. Now it is endangered and is being propagated by the Arizona Game and Fish Department. Altogether, there were more than twenty-five species of native fishes spread throughout the state, many of them occurring in the southern portion covered by this book. But now much of their habitat is gone.

As early as 1880 the rivers of Arizona began channel-cutting. No one is really sure why, although there are several theories; excess runoff due to

overgrazing being the most popular. Whatever the cause, the channeling became deeper, and soon the marshes and lagoons along the river valleys were drained and desolate, the vegetation rapidly dying and the animal life either perishing or going elsewhere.

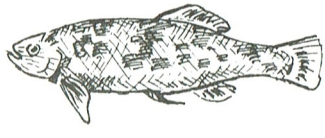
Still, there were many isolated areas left where these river-courses continued to have permanent water, and in these the natives thrived. This condition was short-lived, however, for the construction of dams, the building of irrigation canals to divert the water to the fields, and the lowering of the water tables by domestic and agricultural pumping rapidly changed or even eliminated these remaining habitats. In addition, the introduction of many different types of exotic game fishes further whittled away at the native populations.

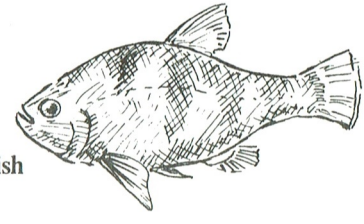
Although few, if any, of the native species have yet become extinct, every one of them has been drastically reduced in numbers and several are on the endangered species list. The Gila topminnow *(Poeciliopsis occidentalis)*, is a good example of a fish which has almost completely disappeared from the fauna of southern Arizona due to predation and competition of exotic species. These tiny, live-bearing fish were once the most prevalent of the natives, but the introduction of the western mosquitofish *(Gambusia affinis)*, a similar, yet more aggressive species, has drastically reduced its numbers.

The desert pupfish *(Cyprinodon macularius)*, is an egg-laying species, and one of the few fishes which can correctly have the term "desert" applied to it. Thriving in waters of high temperature and alkaline content which would kill most species, these two and one-half inch long members of the killifish family are now limited to the waterholes and springs of the Organ Pipe Cactus National Monument. Their main population is centered in the Quitobaquito waterhole, which is located only 100 yards north of the Mexican border. Surrounded by sedge and large cottonwood trees, this spring-fed pond attracts many different creatures to its life-sustaining waters.

In the pond, and in the shallow grass-lined ditches which funnel the spring water to it, the little fish live and breed. The males take on a bright, iridescent blue during mating season in contrast to the drab, speckled brown of the females and immature males. They are quite pugnacious and often engage in mortal combat while defending their individual territories.

Too small to be of commercial or recreational value, but still an important and interesting part of southern Arizona's fauna—the native fishes struggle to exist in a land where little habitat remains which will support their fragile lives.





Desert Pupfish

The Amphibians

Among the creatures which share the aquatic environment with the fishes are the amphibians. These are distinguished from other vertebrates by a life-cycle which includes a larval, or tadpole, stage. Amphibians lay their eggs in the water, the eggs hatch into tiny, legless, gill-breathing creatures, which gradually grow limbs, lose their tails and gills, and finally emerge on dry land as air-breathing frogs, toads, or salamanders. Often this cycle takes long periods of time, thereby requiring permanent water sources. For this reason, the bullfrogs, leopard frogs, canyon treefrogs, and other amphibians with long breeding cycles must stay within the confines of the riparian habitat.

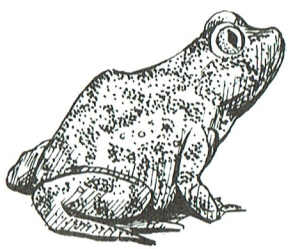
While there is occasionally free-standing water in the desert–particularly during the summer rainy season–these temporary rain pools seldom last for more than a week or so. By adapting to a speeded-up reproductive cycle, desert-dwelling toads–of which there are a number–are able to cope with this short-term water source. The largest of these toads, and one of the most common, is the Colorado River toad *(Bufo alvarius).* This toad, which is as large as a man's hand, is found across the entire breadth of southern Arizona and is extremely beneficial because it consumes countless numbers of insects. Since it takes two to three weeks to go through the tadpole stage, it breeds only in the larger rain pools along arroyo bottoms, and in irrigation overflow areas.

Colorado River Toad

There is one characteristic of the Colorado River toad which somewhat lessens its popularity with humans; it has glandular secretions that are extremely toxic to dogs, should they take the toad in their mouths. This is a protective device designed to deter large predators such as the coyotes, bobcats, and foxes, which are common throughout the toad's range. The toad

is harmless to humans, although the secretion can cause an irritation if a person were to rub his eyes after handling one.

The real speedster of toad reproduction is the Couch's spadefoot toad *(Scaphiopus couchi).* This small toad's cycle runs from egg to tiny land-dwelling toadlet in about a week's time. Spending at least nine months of the year underground in a state of suspended animation, the spadefoot toads dig to the surface as soon as the first heavy summer thundershower penetrates down to their encapsulated forms. Then the night air is filled with a raucous chorus which sounds much like the bleating of sheep. It is the male that does the calling, the silent female coming to the caller. The eggs are fertilized externally in the water as they are laid, hatching within a day or two. The tiny tadpoles feed upon both plant and animal debris in the pool and grow rapidly, leaving the water within a week from the egg-laying process. Although thousands of eggs are laid in one pool, only hundreds will reach the toadlet stage, the tadpoles being devoured by water insects, turtles, and many other creatures. Once they have reached the shore, the toadlets are also extremely vulnerable to predation–particularly by snakes and larger toads, and only a very few of the hundreds will ever reach maturity.



Couch's Spadefoot Toad

The Reptiles

Closely related to the amphibians, but possessing a dry, scaly skin instead of the smooth, moist skin of their water-loving cousins, the reptiles are much better adapted to desert conditions. Their thick skins protect them from moisture loss and serve as armor-plating against some of the other harsh qualities of the environment, while their reproductive cycles are not dependant upon the irregularities of desert waterholes.

There are three groups of reptiles in southern Arizona—the turtles, the lizards, and the snakes. Some are egg-layers, while others are live-bearers. They are found from the low desert to the highest mountains. Most of them are completely harmless and all are beneficial. They range in size from the tiny, three-inch long banded gecko *(Coleonyx variegatus)*, to the common, harmless gopher snake *(Pituophis melanoleucus)*, which reaches a length of over seven feet. Like the fishes and amphibians, they are coldblooded and therefore maintain a body temperature corresponding to the surrounding temperature. For this reason, they must avoid periods of extreme heat or cold, traveling only in the night-time or twilight hours during the summer months and hibernating during the cold winter season.

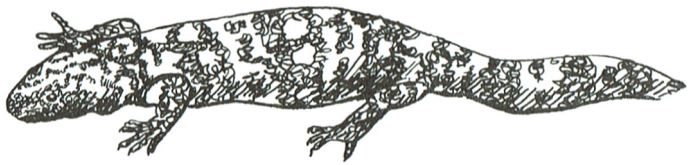
There are several species of turtles, some of them being found in and around the aquatic habitats, but the best-known one, the desert tortoise *(Gopherus agassizi)*, is entirely a dry-land species. They are large, docile creatures which are primarily vegetarian, feeding upon desert grasses and other small plants. In season, they are fond of the juicy red fruit of the prickly-pear cactus. Adult tortoises have few natural predators, but many mammals and birds feed upon the eggs and the newly-hatched young.

In the late summer, the female tortoise digs a depression in the ground with her large front feet, deposits four to 12 eggs, and then covers them up. The eggs incubate for a period of 90 to 110 days. The baby tortoises break through the egg shell by the use of an egg-tooth and dig their way to the surface. Since their hatching usually is in late fall, they soon seek shelter to hibernate until the following spring.

There are many lizards in southern Arizona, most of them quite small in size, exceedingly fleet of foot, and primarily insect eating in habit, although some eat leaves and blossoms. They are sun-loving creatures for the most part, spending much of their time basking upon rocks or tree limbs. Not only do they help to control the insect populations, they also serve as a major food item for many birds, snakes, mammals, and other predatory creatures.

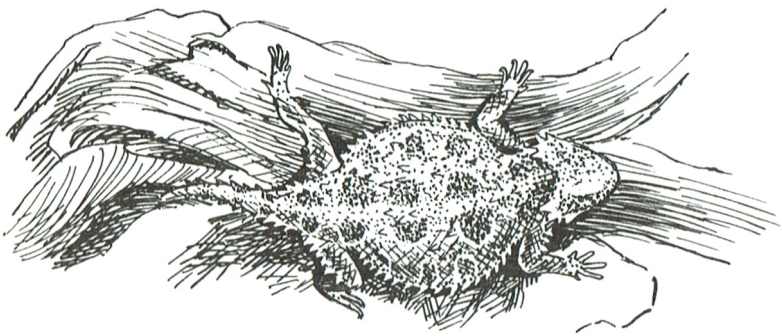
There is only one venomous lizard in the United States, the Gila monster *(Heloderma suspectum)*. This lizard makes its headquarters in southern Arizona. It is also the areas's largest lizard, reaching a length of nearly twenty inches, and is quite heavybodied. It is rather sluggish in movement, but can snap rapidly enough with its powerful jaws when it is disurbed. The only way

a human could be bitten by one of these lizards, however, is to get too close, for they will not attack, but try to escape if they are threatened. Gila monsters are protected by the state laws of Arizona and may not be killed or captured without a permit.



Gila Monster

Gila monsters feed upon a variety of things, but quail eggs are a favorite food. Also included in the diet of these large lizards are young mice, birds, and small lizards. Their venom doesn't seem to be of use in capturing such helpless prey, and is probably only used as a means of speeding up the digestive processes. Gila monsters do not possess hollow fangs like the rattlesnakes, but have grooved teeth in the lower jaw where the venom glands are contained.



Horned Lizard

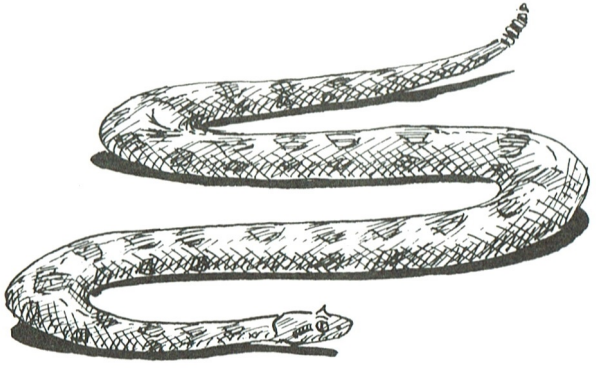
Another well-known lizard of the southwest is the horned "toad." Different species of these thorny creatures are found from the low deserts to the high mountains and feed almost entirely upon ants. The lower desert forms are egglayers, while the mountain types give birth to living young. This is also true with some of the other lizards of the area, and may be due to the fact that the season for activity is much shorter in the higher elevations, therefore necessitating faster reproduction.

The regal horned lizard *(Phyrnosoma solare)* is the most common of the desert species and is equipped with the largest crown of horns. It, like the

others, possesses a unique means of protection besides its thorny hide, for when disturbed it may squirt a stream of blood from vessels in each eye. This is probably an involuntary reaction, caused by the approach of a predator. This blood, although harmless, when squirted into the face of a coyote, for example, might momentarily startle it and cause it to lose track of the fleeing lizard.

There are a number of snakes in the area, some of them very small and inconspicuous, while others are quite large or colorful. Most are non-venomous and beneficial, many of them feeding upon rodents. Ranchers and crop-growers particularly are glad to have them on their property. The only ones dangerous to man are the coral snake *(Micruroides euryxanthus)* and the several species of rattlesnakes. The coral, however, is small, non-aggressive, and has never been known to cause a single death in the state of Arizona. This red, black, and yellow snake is distinquished from other similarly banded snakes in several ways. Its head is entirely black, while other species have a whitish or yellowish nose. All of its bands go all the way around its body, while at least part of the bands on the harmless types do not. The black and red bands do not touch, but are separated by the yellow or whitish bands. On most other species the black and red bands are together.

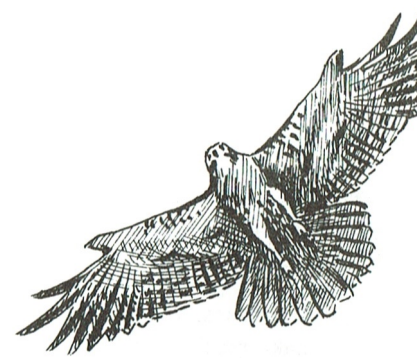
Of the rattlesnakes, the largest is the western diamondback *(Crotalus atrox)*. This snake reaches a length of over five feet, although specimens this size are rare. Several of the high mountain forms seldom surpass two feet in length, while most of the others average around three feet or less. One of the most interesting is the sidewinder *(Crotalus cerastes)*, so called because of its curious sideways looping movement which it employs when traveling over loose sand. The sidewinder lives only in low desert country and is light tan in color to match its surroundings. It is often called the horned rattlesnake because of the enlarged scales over its eyes. Like all rattlesnakes, it has a rattle on the tail and is armed with retractable fangs which inject the potent venom.



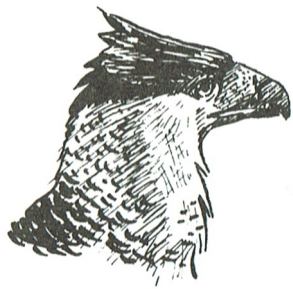
Sidewinder

Most of the area's snakes are nocturnal in habit, with the exception of a few species such as the racers *(Masticophis sp.)*, and the patch-nosed snakes *(Salvadora sp.)*. Some of the smallest forms are burrowing snakes, feeding upon insects and insect larvae, while many of the larger types eat frogs, toads, lizards, birds, mice and other rodents, and even other snakes. In turn, they are eaten by predatory birds, such as the roadrunner, the hawks, the owls, and by many of the mammals. Smaller specimens, even juvenile rattlesnakes, have been known to be eaten by the greedy Colorado River toad.

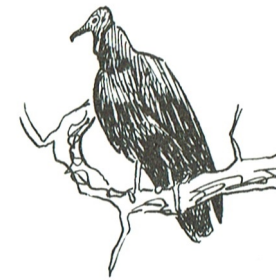
Golden Eagle



Red-Tailed Hawk



Audubon's Caracara



Black Vulture

The Birds

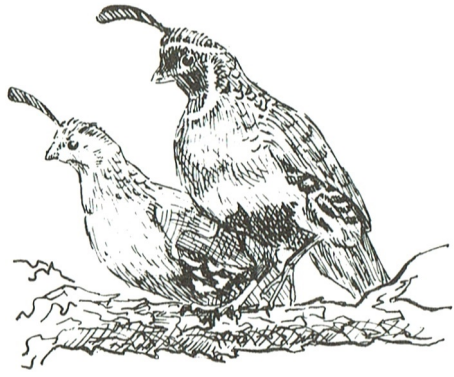
Parts of southern Arizona have often been described as a birdwatcher's paradise, for not only are there many indigenous species, but the area's location in the migratory flyways provides sightings of many transient species as well. Along the lower Colorado River, and in other areas where there is permanent water, many species of waterfowl and shore birds are prevalent, while even certain types of sea-going birds may be seen, due to the close proximity of the Gulf of California. Tropical storms moving up from this large sea often carry stragglers far inland, and desert residents are sometimes surprised by the sight of a tropical bird, pelican, or cormorant in their yards or patios following such a storm.

Two species of vultures are residents of the area, as are many different species of hawks, owls, and other birds of prey, including the osprey, caracara, and golden eagle. The smallest bird of prey is the elf owl *(Micrathene whitneyi)*, a tiny creature of approximately six inches in height. The elf owl is closely associated with the saguaro cactus, living in holes previously hollowed out in these large plants by woodpeckers. Their food consists of insects, scorpions, and other small invertebrates.

While the mountain-dwelling birds of southern Arizona are many and varied, the desert birds are most often seen, and are therefore the best known. Among these is the Gila woodpecker *(Centurus uropygialis)*, which is the species usually responsible for the holes in the saguaro cactus. This common, striped woodpecker feeds upon insects, not only drilling them out of dead trees, but also picking them off living vegetation. Gila woodpeckers are often seen perched upon the large flowerhead of an agave bloomstalk, catching the insects which come there to feed upon the pollen and nectar. The male bird is easily distinguished from the female by the round red cap on his head.

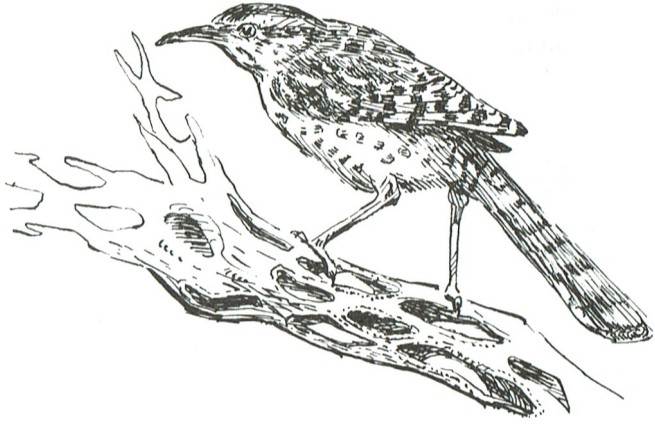
Elf Owl

Gila Woodpecker



Gambel's Quail

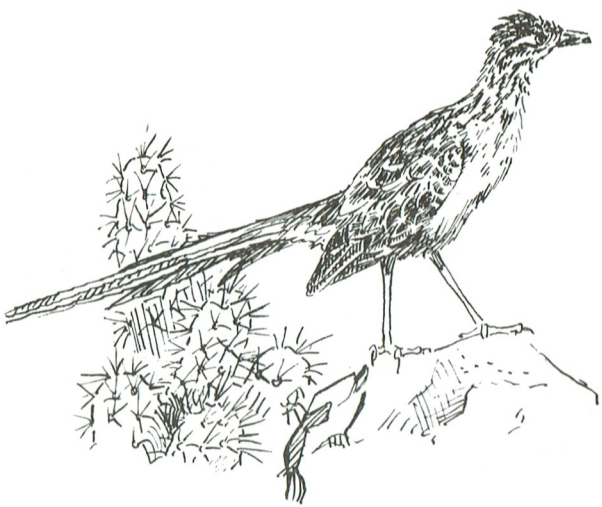
One of the most popular of the game birds in the area is the Gambel's quail *(Lophortyx gambelii).* This ground-nesting bird may lay from 10 to 20 blotched eggs beneath a bush or cactus, but many of them never hatch, as they are eaten by snakes, lizards, foxes, coyotes, and birds. Of those that do hatch, few will reach maturity, the young also being prey of numerous predators. But this plume topped little bird is extremely prolific in spite of the adversity, and a covey of Gambel's quail scurrying across the road or through the underbrush is a common sight throughout southern Arizona.



Cactus Wren

Most people think of a wren as a tiny bird, somewhat smaller than an English sparrow. While that holds true with some of the wrens which occur here, there is quite a contrast in the eight-inch length of Arizona's state bird, the cactus wren *(Campylorhynchus brunneicapillum).* This large, heavily spotted wren usually makes its nest in the protective spiny branches of the jumping cholla, where few predators can reach it. The straw nest is oval-shaped, completely enclosed except for the small entrance hole in one end. Snakes are one kind of creature which are able to penetrate the formidable fortress of the cholla spines and will try to do so frequently. A loud, scolding chorus of the birds is quite often the indication of the presence of one of these scaly intruders.

Bird-lovers in southern Arizona all have their favorite species. Some may choose the brilliantly colored hummingbirds, while others might pick the sweet-singing mockingbird, or the mischievous raven, but the most popular of all is the strange-looking bird which has gained nation-wide prominence from the cartoon series of the same name—The Roadrunner.

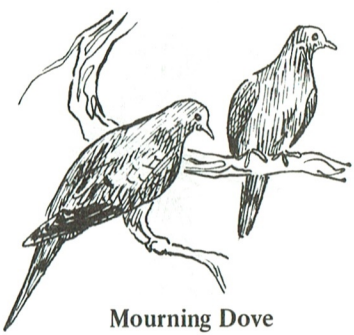


Roadrunner

The roadrunner *(Geococcyx californianus)*, is actually a member of the cuckoo family. Unlike most cuckoos, the roadrunner spends most of its time on the ground, running rapidly to and fro in pursuit of its food, which consists of anything from snakes and lizards to insects and mice. This two-foot-long bird is often credited with the destruction of rattlesnakes, but its snake-killing ability is actually limited to very small, swallowable individuals, the large ones being wisely left alone.

The song of the roadrunner sounds much like the cooing of a dove. The nest is a shallow stick affair, usually a few feet off of the ground in a bush or cactus. While known for their running ability, the roadrunners can fly quite well, and will do so for short distances, if necessary.

From mountain top to valley floor, southern Arizona is a land filled with birds. Some are as rare as the spectacular coppery-tailed trogon *(Trogon elegans)* which is found only in a few of the higher mountain ranges, while others are as common as the mourning dove *(Zenaidura macroura)*, which nests throughout the desert and mesquite grassland. Some, like the great horned owl *(Bubo virginianus)*, are predators, while many feed only upon seeds. All are extremely important members of their environment, for they are responsible for keeping in check the many populations of rodents, insects, and other animals, plus many species of plants, which would otherwise increase to such numbers as to upset the delicate balance of the habitats in which they live. At the same time the birds, and their eggs, become important food items for many of the predators. Some take part in the pollination of certain types of plants.



Mourning Dove

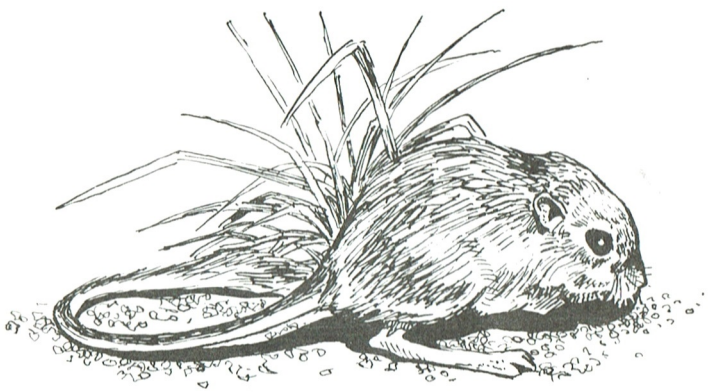
Great Horned Owl

The Mammals

Although there are not nearly as many different types of mammals in our area as there are birds, they are more varied in size and habits. The smallest of this group–which are distinquished from all other creatures by the fact that they possess hair and suckle their young–is the two and one-half inch long desert shrew *(Notiosorex crawfordi).* Found in the desert and grassland, this tiny creature feeds upon tiny insects and other small animal life. The largest is the well-known black bear *(Ursus americanus)*, weighing up to 400 pounds. Black bears are usually restricted to the mountainous regions, although an occasional hungry individual has been known to come down into the low foothills in search of food.

While there are mammals which can actually fly (the bats), many of them are burrowing creatures, living in underground dens to escape the extreme climatic conditions of the region. Among the best adapted of these are the kangaroo rats *(Dipodomys sp.)*, which live in the lower desert areas, digging burrows beneath the protective roots of the creosote bush and other desert vegetation.

Kangaroo rats are able to live entirely without water, even though they feed primarily upon the dry seeds of desert plants. They are able to do this through a special metabolic process of the food which they eat, kidneys adapted to produce only dry waste, and by spending the hot, dry hours of the day deep within the cooler, more humid confines of their burrows, coming out to feed only at night.



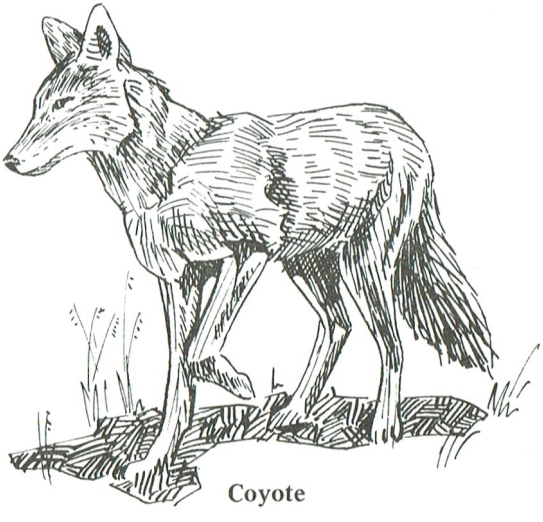
Kangaroo Rat

These small, tannish-colored rodents with the large hind legs and long tails are extremely fast and agile, yet are still a major food source for many predators. The great horned owl, the rattlesnakes, and many of the larger mammals feed upon the kangaroo rat.

Kit Fox

Another well-adapted, low desert mammal is the kit fox *(Vulpes velox)*, a small, pale-colored member of the dog family which also digs a burrow in which to live and raise its young. It is easily distinguished from its larger cousin, the grey fox *(Urocyon cinereoargenteus)*, by its smaller size and extremely large ears, which not only aid in its hearing ability, but also become heat-radiators, helping to lower its body temperature.

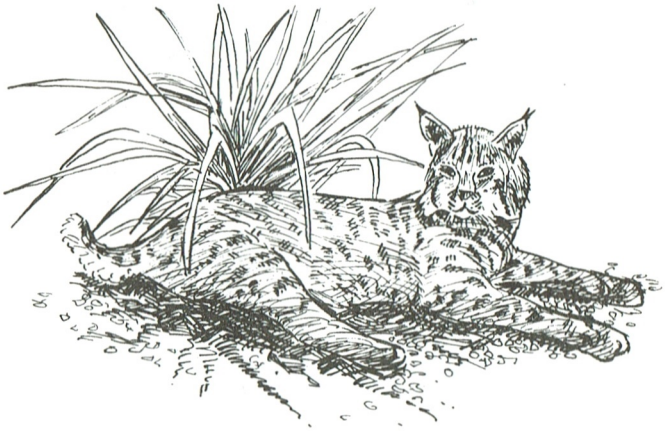
While the kit fox likes the low, sandy areas, the grey fox prefers the higher desert and foothills. Even tree-nesting birds and tree-dwelling lizards are not safe from this agile creature, for it is a good climber and often becomes arboreal in its search for food.



Coyote

An even larger member of the dog family is the coyote *(Canis latrans).* This much-maligned creature is quite common throughout southern Arizona and, although often solitary, may sometimes be seen in small packs. Despite its reputation to the contrary, the coyote feeds primarily upon small animals, such as jackrabbits, cottontails, and many different species of rodents. It is also fond of certain fruits and berries, as are its fox cousins.

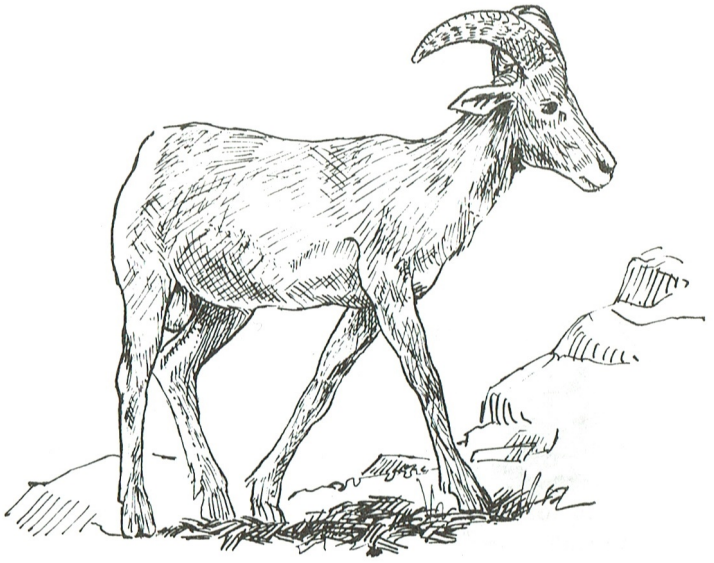
There are several species of wild cats in southern Arizona, including the mountain lion, the jaguar, and the ocelot. But the most common, and usually the only one which the average person sees, is the bobcat *(Lynx rufus).* Best recognized by its short tail, the bobcat—also called wildcat—is a skillful predator, feeding upon reptiles, birds, and mammals.



Bobcat

One of the largest and most wary of the mammals is the desert bighorn sheep *(Ovis canadensis).*, Weighing up to 275 pounds, an adult male possesses a massive pair of spiraling horns. Bighorns live in the hot, rugged desert mountain country of southwestern Arizona, as well as along isolated ridges of some of the higher mountain ranges. Besides the bighorn, southern Arizona's wild hoofed stock consists of antelope, mule deer, and white-tailed deer.

Skunks, badgers, raccoons, coatis, and numerous other medium-sized fur-bearing creatures are included in the mammal populations. There are also prodigious quantities of squirrels, rats, mice, and other rodents which provide food for the predatory reptiles, birds, and mammals living here. Hunter, or hunted, the mammals are among the most interesting members of the vast array of southern Arizona's animal kingdom.



Desert Bighorn Sheep

SUMMARY

Although the animals in the preceding chapter have been described in groups of their own kind, this has been done only to show their physical relationship to each other. In nature, no such grouping exists. Instead, there is a blending together of all species of plants and animals which forms a complete, functional, complex system often referred to as a "biotic community."

While this community, if left undisturbed, may seem to remain relatively unchanged, there are actually small changes taking place constantly. We can best see this by starting with the rock strata of the area. If the solid rock were to remain unchanged, it could support little life. But the ravages of wind, rain, and the constant expansion and contraction due to changing temperatures gradually erode away its surfaces, wearing it down into smaller and smaller pieces of material. Lichens—those strange combinations of a fungus and an alga—attach themselves to the rock faces and through their acid secretions add to the deterioration of the strata.

Wherever the worn-away rock material—in the form of sand and gravel—becomes deposited in a depression, it provides a spot where seeds can germinate and plants can grow. It is in these growing plants that the most vital function of the whole community takes place—a chemical process without which no life could exist—the process of photosynthesis.

By drawing in water through its roots, and carbon dioxide through its leaves, a plant is able to use this process to produce sugar, the carbohydrate which is necessary to sustain life. To do this the plant must have one other item—sunlight. The energy of the sun's rays activate the plant's chlorophyll which actually splits the water molecules, beginning the complex chemical reaction which produces the life-giving sugar, while at the same time giving off oxygen, replenishing the atmosphere's supply of this vital gas.

The plants are then fed upon by a myriad of creatures which are in turn eaten by many larger, predatory animals. The energy, originally converted by the green plants, is therefore passed on to all creatures, whether meat-eating or vegetarian. "Food-chain" is a term often used to describe this series of events by which energy is passed from one living organism to another.

One such food-chain might be as follows: A number of grasshoppers feed upon a certain species of plant. These are devoured by a lizard during its daily feeding routine. In turn, a large snake eats the lizard. The snake is then snatched up by a red-tailed hawk, who proceeds to consume the unfortunate reptile. Here the chain is complete, for the red-tail is seldom eaten by anything larger and is considered a "prime-consumer."

The variations of this "chain" are endless. In an aquatic environment it might be an algae-eating fish, eaten by a larger fish, in turn consumed by an otter, which might finally be devoured by a larger carnivore. The species of

creatures involved are unimportant, the fact remaining that every creature in the biotic community, small or large, feeds upon other living organisms, each one helping to keep in balance the population of others.

It is interesting to note that the small creatures which are fed upon by many others–like the insects, for example–produce the most offspring–one brood often numbering in the hundreds–while those at the other end of the food chain, such as the bobcats or the hawks, usually have only two or three young. The number of young successfully raised depends largely upon the availability of the food supply. During periods of excess precipitation the resulant increase in plant life may trigger population explosions of plant-eating insects. This in turn offers more food for the insect-eating creatures, and the population is soon brought under control. In times of drought, the opposite may be true, with the reproduction of many plants and animals dropping to extremely low levels.

The occurrences of flash floods and fires may also cause temporary disruption, but the plants and animals of the affected area soon adjust to the situation. The environment may return to its original state, or perhaps remain somewhat altered, supporting a new group of living things. This is often the case where a large fire passes through a forested area. If the large conifers are destroyed, new ones will not come back, for the seedlings must have shaded protection in which to grow. Therefore trees of a different species–such as the aspen–fill the empty space, growing rapidly to provide cover for many things, including seedling conifers, which will eventually take over the area once again.

Usually fires are thought of as being something evil, but they are really as much a part of southern Arizona's environment as the rain, sun and wind. Although it is true that some fires are man-made, many are caused by lightning, and this type of fire was here long before man found his way into southern Arizona.

In a pine forest the underbrush–consisting of many species of smaller plants–begins to grow up beneath the tall trees. If small fires occasionally burn this out, the area stays comparatively clear, with the large timber little affected. But if man does not allow the small fires to burn, the thickets become dense, and when a bad fire does occur, even the large conifers will go. In grasslands and hill country, as well as in the forests, fire is the medium which clears up the debris of previous years, and the area which has recently been burnt is often the greenest and most productive during the following months. Fire is often a life-giver, for there are certain species of trees whose seeds most go through intense heat in order to germinate.

Like fire, everything which exists in the biotic community is of importance. While mankind may not always understand exactly what the importance is, it is never-the-less there. Flies, which pester us constantly, are

often looked upon as creatures of no purpose, as is indicated by this excerpt from the poem by Ogden Nash:

God in His wisdom made the fly,
and then forgot to tell us why.

But flies *are* extremely important. Not only do they provide food for many other creatures, but their larvae—often called "maggots"—feed upon refuse, converting it into usable material.

Nothing goes to waste in the natural world. It is a physical law that energy cannot be destroyed, only changed. Animal excrement, the leaves and needles falling from the trees, decaying plants and animals, all are broken down by natural processes and mix with the fragments of eroding rock to form nutrient-laden soils which support the plants. Fallen logs slowly decay, becoming both food and shelter for many living things. Large fungi grow upon their sides, burrowing beetles and carpenter ants drill through their interiors, and termites feed upon the fibers, converting cellulose into usable energy through the help of microorganisms which live within their digestive tracts.

Day after day, season after season, year after year, the varied biotic communities of southern Arizona function with only minor fluctuations and disturbances. Left to themselves, these communities would continue to do so with some degree of stability. But unfortunately, they are not left alone. The human population of the area continues to rise. More and more desert and wooded areas are destroyed, the water table is lowered, and stream-beds are channelized. The flora and fauna of the area suffer.

It is not just the large-scale destruction of habitat which hurts an area. There is destruction which can occur within a park or wilderness area just as well. A stone or a log rolled over, exposing its underside to the elements, destroys the microhabitat of many creatures. A stone or stick thrown into the side of a forty-foot saguaro may start an infection which—in a few weeks—will destroy a plant which may have been a foot tall the day the Declaration of Independence was signed.

Releasing an animal into an area in which it does not belong is another way of hurting the environment. Such animals may multiply rapidly and kill off—either through competition for food, or by direct predation—some of the native wildlife. The unnecessary killing of predators, such as bobcats, coyotes, foxes, hawks, and owls, may cause an increase of rabbits, rodents and other creatures which may wipe out crops or other human possessions. The careless use of pesticides may not only eliminate a specific pest, but also many beneficial creatures as well, perhaps even a species which was holding some even more destructive pest in check.

Of all the creatures living on this planet, man alone has the ability to completely destroy all life. But also, he alone has the capability to think, to

reason out the situation, and to control it. As individuals, we must realize that we are not just spectators, but bona fide members of the vast, complex environment in which we live. We should learn to protect it, to enjoy it, and to pass it on to tthe generations which follow.

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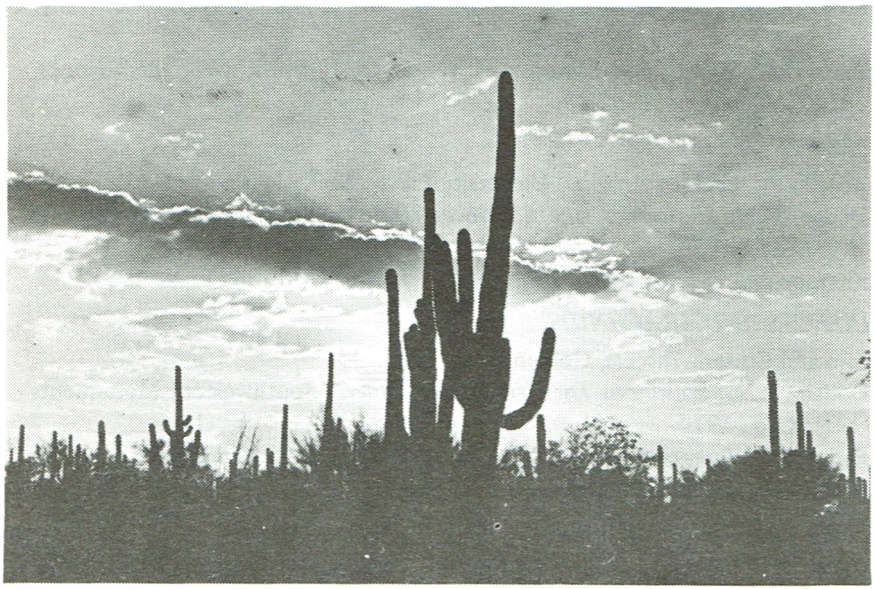
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